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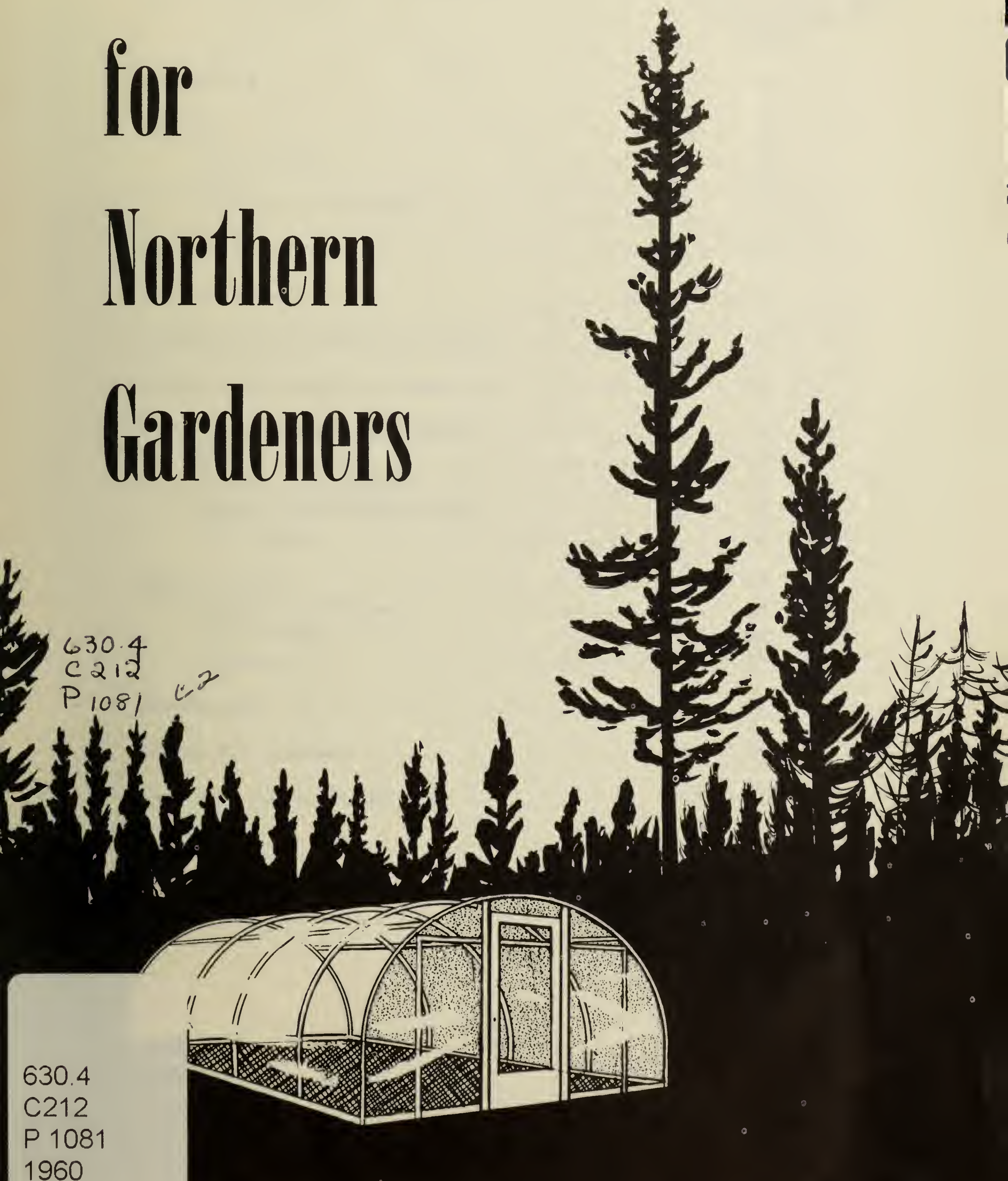
Handbook for Northern Gardeners



EARCH BRANCH

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A HANDBOOK FOR NORTHERN GARDENERS

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INTRODUCTION

Gardening in the Canadian North can be profitable, useful and interesting. The extent of gardening will depend on the soil available, climate, need and uses of the crop, time and interest devoted to the work, and resources and facilities for gardening.

Where there is a will there is a way of growing vegetables and flowers in many northern regions. The limits of success are governed by climatic conditions and availability of good soil. These limits may be extended considerably by suitable cultural practices, proper fertilization and the use of hardy varieties.

It may be argued, of course, that there is no point in growing plants under extreme difficulties and when costs are excessive. On the other hand, the returns may be something more than money saved and may be measured in terms of achievement and sheer satisfaction. A missionary at Old Crow, Yukon, grew a flower box of wheat to maturity for several years to show the people of that community the source of their bread and bannock. To avoid cool nights and probable frosts he had to move the box indoors every evening but he achieved much satisfaction from the project.

Man cannot change the climate, but no matter where he may be located he can provide a favorable local environment and adopt methods and techniques beneficial for the growth and development of plants.

If the local growing season is short, it must be extended. How this may be done is described in paragraphs that follow. If the soil contains perma-frost, steps must be taken to warm up the soil by means of electric heating cables, shelters, hotbeds or greenhouses, or by other cultural practices. If the soil is poor, it must be suitably enriched. The choice of crops and early maturing varieties is more important in the North than it is in the warmer parts of Canada.

This booklet is prepared for beginners in gardening in the North. No attempt is made to be technical. For further information the reader should consult the references listed at the end of this handbook, or apply to the nearest experimental farm or station.

THE SOIL

Deep sandy loam containing sand, clay and abundant organic matter is ideal for gardenina. Some gravelly and clay loams are also good. Light soils

containing only a little clay are classed as early soils because they warm up quickly in the spring. Clay loam or heavy clay soils are harder to work and must be handled carefully. If heavy clay is dug or plowed when it is wet hard lumps will form when it dries and the preparation of a fine seedbed will be difficult. Soils with much raw organic matter such as tree roots and undecomposed leaf litter are not desirable either. The very act of decomposition of the raw organic matter robs the vegetables or garden crops of plant food and moisture. When such a condition is present, the soil must be made ready by mixing certain substances in it, and this should be done the year before the seeds are planted.

Soil Fertility

Well-rotted manure is an ideal soil amendment or conditioner. It contains nitrogen, phosporic acid and potash, essential plant foods, in proportions of about 10-5-5. Manure also improves the moisture-holding capacity of the soil. By opening heavy clay soils it allows air and water to penetrate more thoroughly. If manure is not available (and in many remote regions livestock are not regularly kept) grass clippings, plant refuse, peat and other organic matter can be used, provided that they have become well rotted in a compost heap. To improve the compost, it may be desirable to add small amounts of fertilizer, night soil, soot or wood ashes.

When manure is not added to the compost pile, decay will be more rapid if some food is supplied for the bacteria that bring about the rotting. This food may be supplied by distributing evenly through the compost heap a small quantity of nitrogen and some lime to reduce the acidity. Commercial cyanamid, which contains 20 per cent nitrogen and the equivalent of 70 per cent hydrated lime, is a handy preparation.

A combination of the main plant foods is even better and it may be prepared at home by mixing together 40 pounds of sulphate of ammonia, 40 pounds of superphosphate, 10 pounds of muriate of potash and 20 pounds of ground limestone. The ground limestone may be replaced by 40 pounds of unleached wood ashes. Four to six pounds of this mixture should be added to each 100 pounds of organic waste material and distributed evenly through the heap.

Peat and muck found in many swamps and bogs and in former lakes and stream beds may be useful soil amendments in the North. Peat is semidecayed vegetable matter, usually showing the structure of the plants from which it is derived. It is often fibrous, woody or moss-like and varies in color from light to dark brown. As a rule, it contains only small amounts of mineral matter. Muck is mainly vegetable matter that has decomposed or decayed further than peat. Usually the plant tissues are well broken down so that the original plant structure is not noticeable. Muck is black or dark brown and when wet it is of an oozy consistency.

Peat and muck differ in value because they vary in stage of decomposition and often may be acid in reaction. Plant food is not present in readily available form and, as in the composting of other organic materials described earlier, rotting is necessary.

For further information the reader should refer to "Manures and Composts", Canada Department of Agriculture Publication No. 868.

Lime

Some soils need lime before they will grow good vegetables. If the soil is acid you should apply agricultural ground limestone at the rate of 1 to 2 tons per acre or about ½ to 1 pound for each square yard of garden. Lime should be applied in the fall and worked well into the soil.

Commercial Fertilizers

As barnyard manure is not generally available, it is necessary to use commercial fertilizers to fortify garden soils. Probably the first reason for using commercial fertilizers is that food should be available as soon as the crops are planted. This is of great value in the colder regions, where the growing seasons are short. Sandy or gravelly soils may be low in fertility.

There are a number of fertilizer mixtures available on the market. The choice of formula will depend on the needs of the soil and the crop grown. As the cost of transportation is high it is advisable to use fairly concentrated forms of fertilizer. The higher the figures in the formula, the higher is the concentration of the essential elements. These are always in the same order on the label or bag: nitrogen (N), phosphoric acid (P_2O_5), and potash (K_2O). For example, a 4-24-12 fertilizer contains 4 per cent nitrogen, 24 per cent phosphoric acid and 12 per cent potash.

The rate of application of a fertilizer may be varied according to the fertility of the soil and the food requirement of the plant. In general leafy plants require more nitrogen and slightly less phosphorus and potash than those that produce tubers. Potatoes and other root crops are better when nitrogen is reduced and when the mineral content, particularly potash, is fairly high.

No one fertilizer mixture can be expected to meet all conditions with all crops. In general, such crops as potatoes, carrots and turnips will likely respond to a 4-12-10 fertilizer at 1,000 pounds per acre. This works out to just under 25 pounds of fertilizer per 1,000 square feet of garden area.

The fertilizer may be broadcast or applied in the row. If the latter method is followed, care should be taken so that the fertilizer does not come in contact with the seed. This is especially necessary when the more highly concentrated forms of commercial fertilizers are used.

Dig or plow the garden in the fall. Leave the area rough so that it will trap and hold the snow. This also helps to warm up the soil in the spring and reduces erosion. If rotted manure is available, spread it over the surface before digging or plowing. Apply it at about 1,000 pounds to 1,000 square feet of garden area. Well-rotted compost, prepared as already described, may be used if manure is not available. Commercial fertilizer should be applied after the garden is dug or plowed. Fertilizers such as 4-12-10 may be applied at 20 to 30 pounds per 1,000 square feet and worked into the topsoil with a rake or harrow.

Work the garden soil to a depth of 8 to 10 inches so as to cover all the manure, compost or other litter. Shake out grass roots and sod but leave the surface of the garden lumpy. The following spring dig the garden with a fork and remove any remaining grass roots that are alive. Pulverize the soil with a garden rake and make the surface smooth to obtain a uniform stand of plants from seeds or transplants. If the area is large enough for a small tractor, then the main implements for spring work are: spring tooth cultivators, disk harrows, drag or smoothing harrows and, in some cases, a float made from planks or logs.

The names and formulas of some of the fertilizers are given below.

Fertilizer Material	Percentage		
	Nitrogen	Phosphorus	Potash
Ammonium phosphate	11	48	0
Ammonium nitrate	33	0	0
Cyanamid	21	0	0
Nitrate of soda	16	0	0
Superphosphate	0	20	0
Triple superphosphate	0	46	0
Muriate of potash	0	0	60
Sulphate of potash	0	0	48
Plant starter	10	52	17
Ready mixed	10	10	10
" "	4	24	12
" "	4	24	20
" "	4	24	20
" "	4	12	10
" "	3	18	15
" "	6	12	12
" "	0	20	20
" "	5	10	13

PLANNING THE GARDEN

There is fun and satisfaction in drawing elaborate plans of your garden, even if you change your mind later. Prepare a planting plan long before you begin your spring work. To do this, you need to know the kinds and amount of seeds you intend to grow, and the required spacing between rows. The widths between rows of various crops may be obtained from the table on p. 10, or from the instructions on the packets of seed. The table also gives the approximate amount of seed needed for a 50-foot row or the length of row each packet will sow.

SOWING THE SEED

For depth of sowing and spacing of the rows follow the instructions on the seed packets or in the accompanying table. Sow the seed only thickly enough to get a good stand. Most people use far too much seed per row; this wastes the seed and makes more work in thinning the plants for proper development. Some seed may be sown thickly; then part of the crop may be used at the time of the thinning and the rest left to develop to maturity. A good example is beet. If the seeds are sown about an inch apart, and if germination is good the plants will have to be thinned and spaced about 2 to 3 inches apart to permit full development. The plants that are pulled out make excellent greens. Thinning should not be delayed too long, however.

Most seeds may be sown in a shallow trench made by drawing the corner of the hoe or a sharpened stick along a line or a tight rope. The drill should be the same depth all along so that the seeds may be covered evenly.

Large seeds, such as peas, may be individually placed at the specified distances. You may plant small seeds, such as carrots and lettuce, directly from the packet by tearing off a corner and gently tapping the envelope with a finger as you proceed along the row. Cover the seed and press the soil firmly. Some people like to do this by standing on a long board placed directly over the planted row, and in this way firming the soil evenly without punching it.

For some vegetables it is well to sow two or three varieties that mature at different dates. These may be sown on the same date but they will be ready for use several days apart. In some areas later crops of lettuce, radishes, beets and spinach may be grown after the first crop is harvested.

Methods of cutting and treating seed potatoes for planting are given in detail in Canada Department of Agriculture Publication No. 918 "Potato Growing in Canada".

CULTIVATING AND THINNING THE PLANTS

Cultivating and thinning or spacing the plants may be begun as soon as the seedlings appear. To insure good stands in the face of possible attacks by insects such as cutworms, it is better to cultivate once or twice before finally spacing the plants in the row. Weeds are more effectively killed when hoeing is done on a bright day. Large weeds may be pulled by hand and piled on the compost heap. Thinning is best done on a dull day or in the evening, when the soil is moist.

Cultivating the ground once or twice a week to a depth of 1 or 2 inches is a good practice.. As the plants increase in size, hoeing should be farther and farther away from the plants and cultivation should be shallow so that the roots will not be injured. Some crops may be hilled up slightly as the plants develop. This anchors them better and provides loose soil for growth of roots and tubers. Potatoes should not be planted deep because they need the warmth near the surface of the soil. As the plants develop, they may be hilled up a little at each cultivation until just before they begin to bloom. Then they may be mounded up and left undisturbed until they are dug.

SOME HARDY VARIETIES OF VEGETABLES -- AMOUNT OF SEED TO USE, DISTANCE BETWEEN ROWS, DISTANCE IN THE ROW AND DEPTH OF SEEDING

Kinds	Varieties	Amount of seed or plants per 50-foot row	Distance between rows in inches	Distance between plants in row in inches	Depth to cover seed in inches
Bean (bush)	Round Pod Kidney Wax, Stringless Green Pod, Improved Golden Wax, Tendergreen.	8 oz.	18-24	2-4	1½-2
Bean (pole)	Early Wonder Wax, Blue Lake	4 oz.	36	12-24	2
Bean (broad)	Broad Windsor	6 oz.	24	8	2
Beet	Detroit Dark Red, Globe,	½ oz.	16-24	2	½
	Tall Top Bunching	½ oz.	16-24	1-2	½
Broccoli	Waltham 29, Sprouting Calabrese	1 pkt.	24-36	12-18	Transplants
Brussels Sprouts	Dwarf Perfection, Catskill	1 pkt.	24-36	18	Transplants
Cabbage	Golden Acre, Danish Ballhead, Copenhagen Market	1 pkt.	30	18	Transplants
Carrot	Nantes, Red Cored Chantenay, Amsterdam	¼ oz.	18-24	1-2	½
Cauliflower	Snowball, Snow Queen	1 pkt.	30	18	Transplants
Celery	Utah #15, Golden Plume	1 pkt.	24-30	6	Transplants
Chard, Swiss	Lucullus, Rhubarb	½ oz.	24	6-8	½
Corn (Sweet)	Dorinny, Sugar Prime, Pickaninny, Golden Midget	4 oz.	30-36	8-12	2
Cucumber	Marketer, Mincu, Straight 8	1/8 oz.	36-48	24	½ or transplants

Endive	Deep Heart Fringed, Green Curled	1 pkt.	18-24	6-9	¼
Kohlrabi	Early White Vienna	½ oz.	24-30	4-6	¼
Lettuce (leaf)	Grand Rapids, Salad Bowl	1 pkt.	18	6	¼
Lettuce (head)	Great Lakes, Imperial	1 pkt.	18	12	¼ or transplants
Onion (seed)	Yellow Globe, Sweet Spanish, Yellow Globe Danvers	1 pkt.	18	3	Transplants
Onion (sets)	Red Wethersfield, Yellow, Multipliers or Potato	1½ lb.	18	3	1
Parsnip	Short Thick, Hollow Crown	¼ oz.	24	3-4	½
Pea	Little Marvel, Selkirk, Thomas Laxton, Lincoln, Director	4 oz.	24-36	2	2
Radish	Scarlet Globe, French Breakfast, Cherry Belle, Saxa, White Icicle	½ oz.	12	1	¼
Rutabaga (Swede)	Laurentian, Canadian Gem	½ oz.	30-36	6-8	¼
Spinach	New Zealand, Bloomsdale	½ oz.	18-24	4-6	½
Squash	Golden Table Queen, Uconn, Long White Bush, Early Prolific	1 oz.	60-90	24	1
Tomato	Early Chatham, Farthest North, Manitoba, Meteor, Early Lethbridge	25 plants	36	24	Transplants
Turnip (Summer)	Purple Top Milan, Early White Milan, Golden Ball	½ oz.	24-30	4-6	¼

In the North the growing season is short, so plants must be helped to get an early start and make rapid development. One of the easiest ways is to start the seeds in flats or boxes on a window sill. Later on these flats may be put outdoors in cold frames. After further development and hardening, the crop may be transplanted into the open garden.

Flats

The most satisfactory flat is one about 13 by 22 inches, with sides 3 inches deep. Cut the end pieces of 5/8-inch lumber 12 inches long and the side pieces and the bottom of ¼-inch wood 22 inches long. Nail the boards in the bottom with a little space between each to allow for drainage. Make the flats all of one size so that they can be shifted or replaced by others.

Sow the seeds rather thickly in rows 2½ to 3 inches apart. When the first true leaf is formed transplant the seedlings in another flat 2 to 5 inches apart depending upon the plant, or transplant them into flower pots, berry boxes or paper pots. Set these outdoors in a hotbed, if necessary, or into a cold frame constructed as described below.

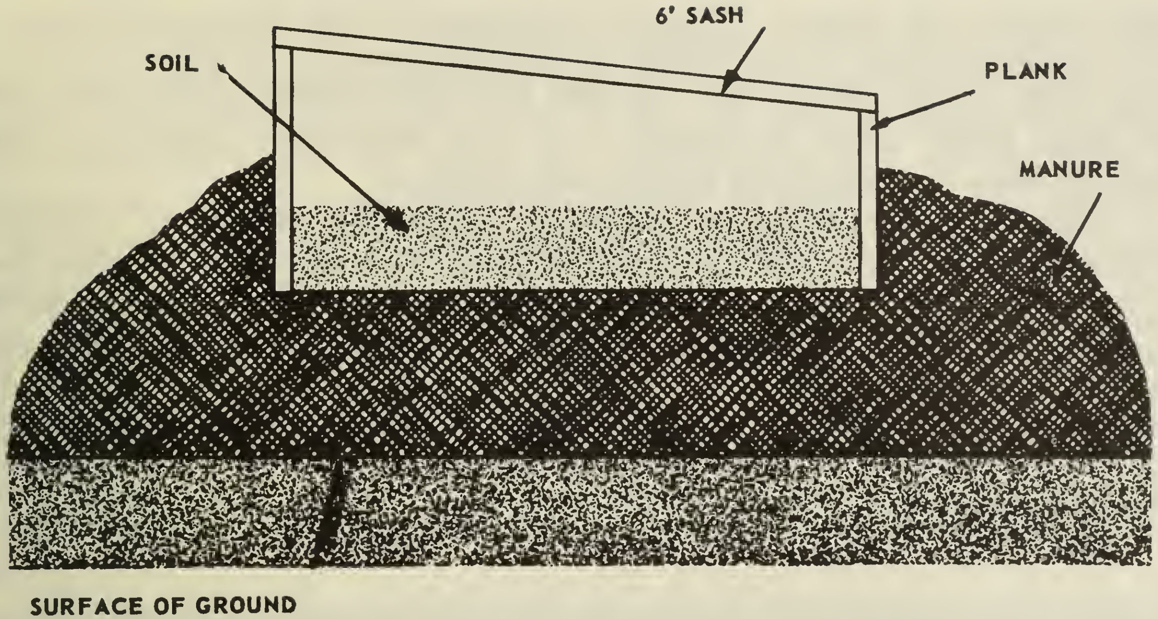
Expose the plants gradually to outdoor conditions for several days before setting them in the open. When the soil seems to be too dry give it a thorough soaking, not just a sprinkling on top, then let the surface dry out for a while before watering again. Light, open soil or sand on the surface of the flats will help to prevent the young seedlings from damping off. Do not allow green mold or algae to form on the surface around the young plants.

Hotbeds with Manure

Hotbeds are a big help in starting early plants. Seed may be sown in early April and May or as soon as the sun is warm, five or six weeks before plants may be safely grown outdoors. The time to start can be determined by trial and error based on one's own observations and notes.

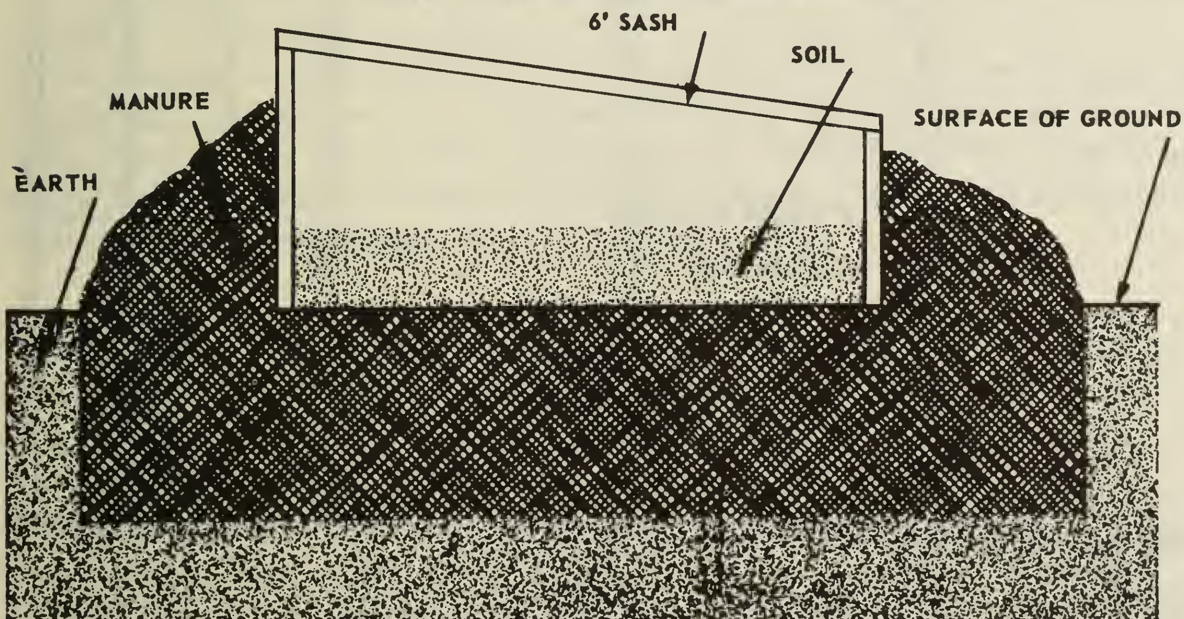
A hotbed should be located on the sunny side of a building or by a board fence where there is some protection from cold winds. One good source of heat for the hotbed is fresh horse manure. It may be piled 2 to 2½ feet high either on the surface of the ground (Figure 1) or in a hole about 2 feet deep (Figure 2). The latter method has some advantage because the cold frame may be placed snugly on the manure and does not extend so high above ground level as to be exposed to cold spring winds. It has a disadvantage in the North in that the ground may still be frozen a few feet below the surface. Both methods are shown in the sketches.

The dimensions of the hotbed depend on the type of glass frames or window sashes that are available. A hotbed frame (Figure 3) is usually made to accommodate four sashes. Each sash is 3 by 6 feet and has 18 lights of 10- by 12-inch overlapping glass to a sash. Build the frame of the hotbed of 2-inch planks at least 13 inches high at the back and 8 inches at the front, in order to give slope



SURFACE HOTBED

Figure 1 – A surface hotbed in cross section.



PIT HOTBED

Figure 2 – A pit hotbed in cross section.

to the glass. Dovetail as illustrated (Figure 3) three pieces of 2- by 4-inch scantling level with the top of the side planks. These pieces give support to the frame and help to carry the sashes.

Leave the manure in the pit or pile for five days, then fork it over, shake it out well, and build the pile up evenly. Water very dry manure to prevent excessive heating and later settling of the bed. Tramp the manure to make sure that there are no slack spots. Place the frames on the manure and cover with sashes. Leave the sashes on for a few days, then open them slightly so that

the gases that form from the early heating may escape. Put in about 5 inches of good soil over the manure. When the temperature of the manure goes down to 80°F. place the flats in the hotbed or plant the seed in the earth. If flats are used, less soil is needed. Set the flats on narrow boards running across the bed. When frosty nights are expected and when beds have little bottom heat, cover the frames with some old carpet, rugs, or straw.

Because of the limited air space in a hotbed the temperature will run up quickly on a bright day and the plants may easily be ruined by too much heat. To avoid this, push the sashes back for a few inches, the exact amount depending on the day and the kind of plants. Tomatoes will stand a higher temperature than cabbages. Water the plants carefully to avoid too high humidity and to prevent the development of damping-off fungi. Usually, watering is done about noon so that the surface of the soil and the air may dry out before the bed is closed for the night.

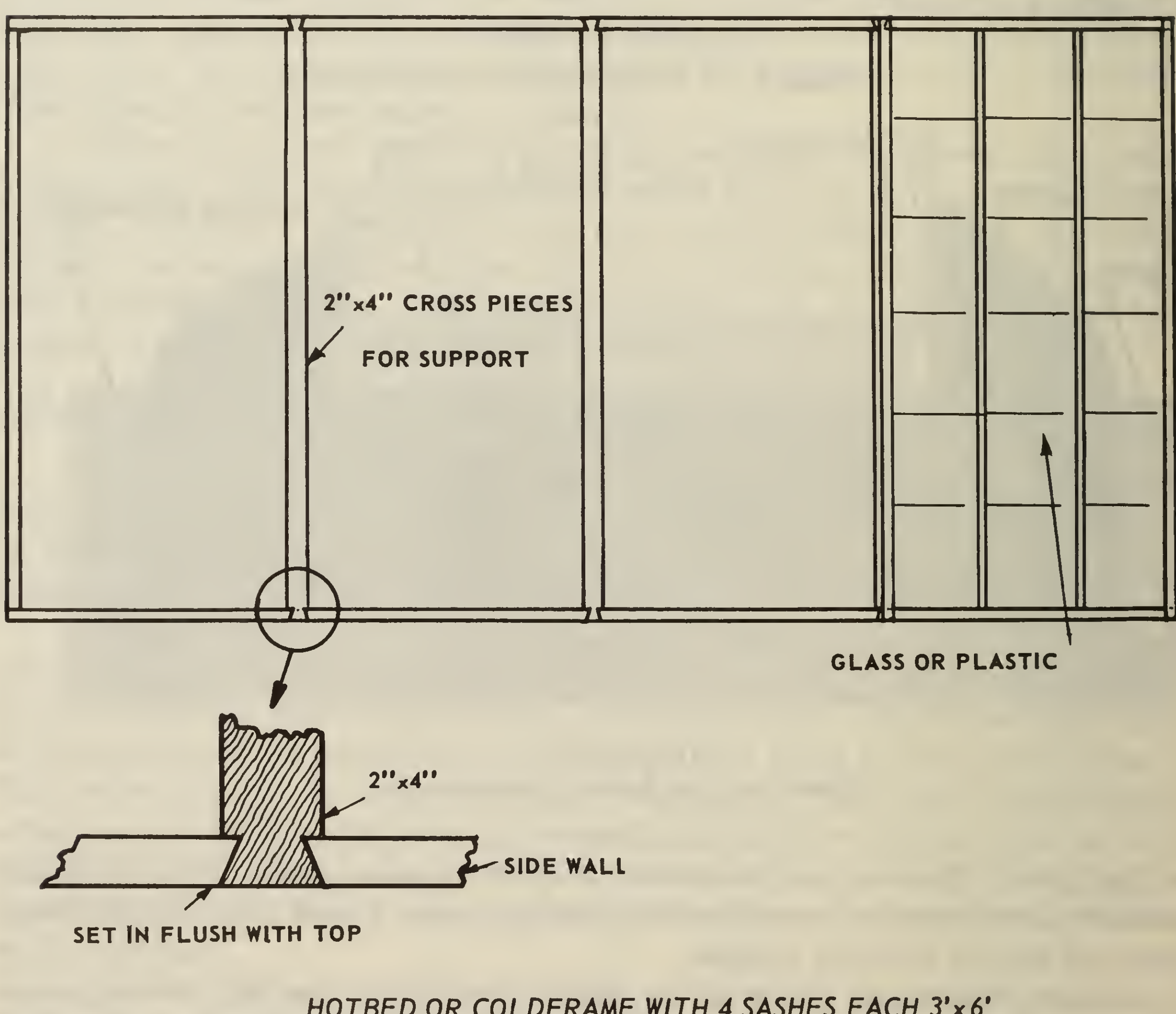


Figure 3 – A hotbed frame for sashes with glass.

Hotbeds with Heating Cable

Where manure is not available as the source of heat and where electric power is provided, heating cables may be used. One heating-cable set, 60 feet in length, will heat 36 square feet of soil, so two sets will be required to heat the hotbed described above. For every two heating-cable sets, one thermostat is needed to regulate the temperature. The thermostat is buried in the soil according to the directions provided with the particular model used. The arrangement of the heating cable is illustrated in the sketch (Figure 4).

Put the hotbed frame into a pit at least a foot deep. Lay the cable out in a bed of sand or fine soil. Cover it with about an inch of sand then over this lay wire screening of ½- to 1-inch mesh to protect the cable when the soil is worked or when plants are being put on it in flats or pots. On top of the wire screen spread about 5 or 6 inches of good soil. Seeds may be planted directly in this earth. If the seeds are first sown in flats, then soil is not needed over the wire mesh.

Electrically heated hotbeds need more water than manure beds. Keep the soil moist, but not wet, down to the cables.

For most seedlings the thermostat, which you must have, may be set at or near 65°F. To do this accurately you need a soil thermometer. You also need an air thermometer to note the temperature of the air inside the hotbed when the sun is fully out. The sashes must be opened during the day but they must be closed in the evening to conserve the accumulated heat. During the night, if the temperatures are near freezing outside, additional cover of canvas, jute bags or other materials may be necessary.

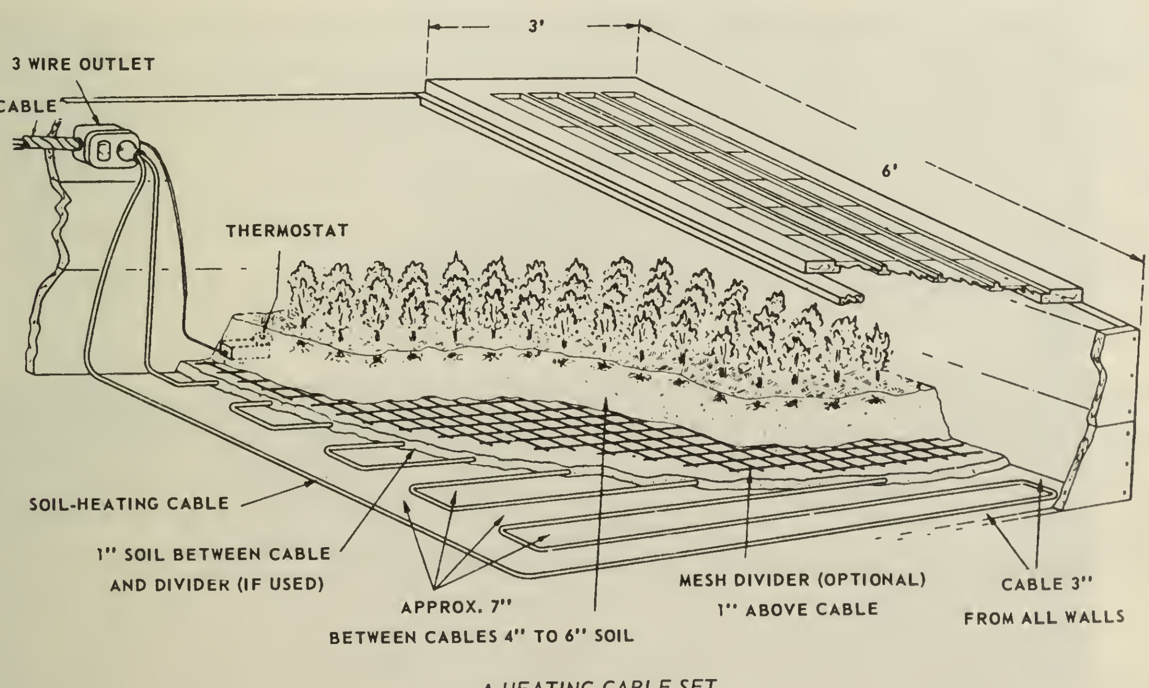


Figure 4 – Heating cable in place in a hotbed.

To eliminate drafts it is important to have the hotbed well banked with soil. When plants are well started and spaced in flats or pots, and if weather permits, the sashes may be removed for part of a day in order to harden the plants before setting them out in the open field.

Cold Frames

Cold frames may be used in conjunction with hotbeds. This is an excellent way to harden plants and so prepare them for early transplanting into the open garden. The seeds may be sown quite early in the hotbed or in flats or boxes indoors; then the plants are spaced out into flats which, in turn, may be put into the cold frame. By this time the weather should be warm enough for the plants to thrive in a well-constructed cold frame but probably not mild enough for them to be put directly in the garden.

The cold frame (Figure 5) is built exactly like the hotbed, but, of course, it has no source of heat. It is best to set the cold frame in a sheltered spot and have it well banked with earth. The plants may be started in good soil at least 6 inches deep or in flats and trays. The cold frame, like the hotbed, may be any convenient size to accomodate the available sashes.

It is well to have the cold frames ready early and have them covered with glass or plastic sheeting by the time the sun is hot. This heat thaws out the frost from the soil and permits early seeding.

Sometimes heat lamps or ordinary light bulbs are used in cold frames to warm up the interiors for a few days when outside temperatures drop suddenly.

Cold frames need a lot of attention once the plants are started. As in the hotbed, the temperature may easily rise above 100°F., when the sun is strong.

Figure 5 – Cold frames beside a lean-to greenhouse at the Experimental Farm, Fort Simpson, N.W.T.

This makes daytime ventilation necessary. At night, on the other hand, canvas, rugs or carpets may be needed to prevent loss of heat.

Satisfactory hotbeds and cold frames can be constructed from logs. The interior should be lined with tar paper or roofing paper, and the logs must be chinked and well banked with soil on the outside.

USING PLASTICS

During the last few years there have appeared on the market various types, grades and gauges of plastic materials that may be used by gardeners. Some of these materials are made of vinyl (polyvinyl chloride) others of polyethylene. Several Canadian companies make and market these plastics under their brand names. Another type of plastic sometimes used is cellulose-acetate-butyrate sheet which is not made here but is available through suppliers. It has some stiffness and is a clear transparent material.

Plastics may be used in place of glass, and, in fact, are preferable because they make costly window sashes unnecessary. Panels may be made from 2-by 2-inch lumber and for ease in handling they should not be larger than 4 by 8 feet. Supporting strips every 2 feet are recommended. If plastics are used in place of glass for hotbeds and cold frames, the back plank of the frame must be made at least twice as high as the front. This extra height is needed because unlike glass, plastics sag considerably and must have more slope to allow rain to run off.

The thinner or cheaper grades of polyethylene are not very durable and if they are used it may be necessary to replace panels even before one season is is over. That is why small squares or narrow panels are preferable. Laths or narrow plywood strips should be used to hold the material because the flapping of the plastics causes tears if only nails or small wire staples are used.

For use in the construction of hotbeds, cold frames or small greenhouses a good average grade of material, and at the same time one moderate in price, is clear polyethylene of 6-mil (.006) gauge. This material comes in rolls 10 by 100 feet and costs roughly 1½ to 2 cents a square foot. In the 4-mil (.004) gauge this material may be obtained in widths of 36, 54, 84, and 120 inches each 100 feet long, at cost of about 1½ cents a square foot. The thinner grade, of course, is not so durable.

For more permanent installations, and particularly if the plastic-covered panels or frames can be stored when not in use, use a clear, 12-mil (.012)-gauge material. This will cost about 10 cents a square foot but is worth the difference.

Plastics may be used in the construction of shelters and hutches, for covering plants in the row, for mulching and also as glazing for greenhouses.

Shelters And Hutches

Shelters covered with plastics may be used to protect plants sown directly in the garden or to cover a garden area where seedlings will be transplanted. Usually these shelters remain in place until the crop is harvested and so they protect plants throughout the season.

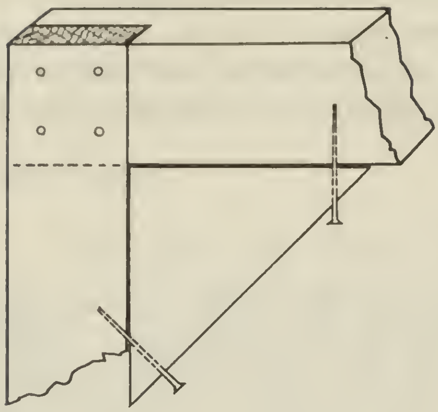


Figure 6 – Detail showing corner-lap construction of wooden frames for crop shelters.

With wooden frames.–Probably the simplest types of shelters can be built of 1-by 2-inch or 2- by 2-inch softwood lumber. The size of the panels or frames will depend on the width of the plastic. Frames, about 4 by 8 feet, are easily made up, particularly if a power saw is available. You should strengthen the frames by using corner laps and blocks (Figure 6). To reduce the amount of flapping of the plastic nail strips of 1- by 2-inch or 1- by 1-inch wood down the middle of each panel. Then cover the frames with plastic by first stapling this material snugly to the outer wood. Over the top of the staples nail narrow strips about an inch wide and cut from the thinnest plywood. Use 1-inch shingle nails to attach these strips.

The panels may now be set up in place. The simplest way is to lean two panels together to form an inverted V (Figure 7). For best results it is advisable to erect two uprights, one at each end of the shelter, 6 to 6½ feet above the ground level. Between these, nail a ridge pole of 1- by 4-inch lumber. Now, slope

Figure 7 – Wooden panels covered with polyethylene used in the construction of various types of crop shelters at the Experimental Farm, Mile 1019, Alaska Highway, Y.T.

the panels against the ridge pole. If the ridge pole is 6 feet high, and 8-foot panels are used, you can cover an area a little over 10 feet wide. If the ridge pole is 6½ feet above the ground, then the 8-foot sides will cover only 8 feet of land. The gable ends of the shelters must be covered with plastic also. At one end there should be a hinged door and at the other a hinged ventilator. This is especially necessary during midsummer.

In practice it has been found best to sow low-growing crops along the sides before the panels are put into place. The center row may be planted or sown after the shelter is erected. (In Yukon, for example, one grower planted beans along the sides, then tomato plants and dwarf corn right under the ridge pole; in all there were six rows which extended the length of the shelter.) The panels are wired to each other at the top. When cultivation is needed the panels may be lifted up on the hinge so formed. The bottoms of the panels may be banked with earth but if it is very windy it is best to drive stakes at the base and to wire the panels to them. The panels should fit tightly against each other, but if the wood is slightly warped, it may be necessary to nail a board over the crack to keep the tent air-tight and to further strengthen the structure.

It is very important not to puncture or tear the plastic as once torn it will continue to tear in the wind. The temperature must be watched during the time the sun is fully out. For a cross draft it will be necessary to open the door and also the ventilator. Some plants, such as cucumbers or tomatoes, must be hand-pollinated to set fruit as there are usually not enough insects in the plastic shelters to do the pollinating.

With metal frames.--There are many variations of plastic-covered shelters or hutches. Very efficient shelters may be constructed of 1-inch aluminum, steel, galvanized or other rigid pipe bent in semicircles about 4 feet in radius. The ends of the arcs are set into specially made tees spaced 2 or 3 feet apart, depending on the width of a continuous sleeve of polyethylene or other plastic (Figure 8). Any number of these panels may be placed side by side to form a long tunnel. The ends of each tunnel are closed by semicircles cut from half-inch plywood sheathing held upright in place by 2- by 2-inch or 2- by 4-inch posts driven into the ground. These plywood ends may be removed to provide ventilation during the hot periods of the day.

The panels are covered by a double layer of plastic material. They are held in place by being banked with earth or wired down to stakes driven into the ground. When work on the plants inside the hutch is needed, these panels may be moved off or propped up without much trouble.

Metal frames will last almost indefinitely, so their high initial cost may be justified. The polyethylene or plastic covers may tear or deteriorate, but the material is the cheapest part of such structures and can be readily replaced. Off-season storage of the panels is simple. They may be stored by nesting a number of them together inside machine sheds or where they would not be torn by heavy winds and snow.

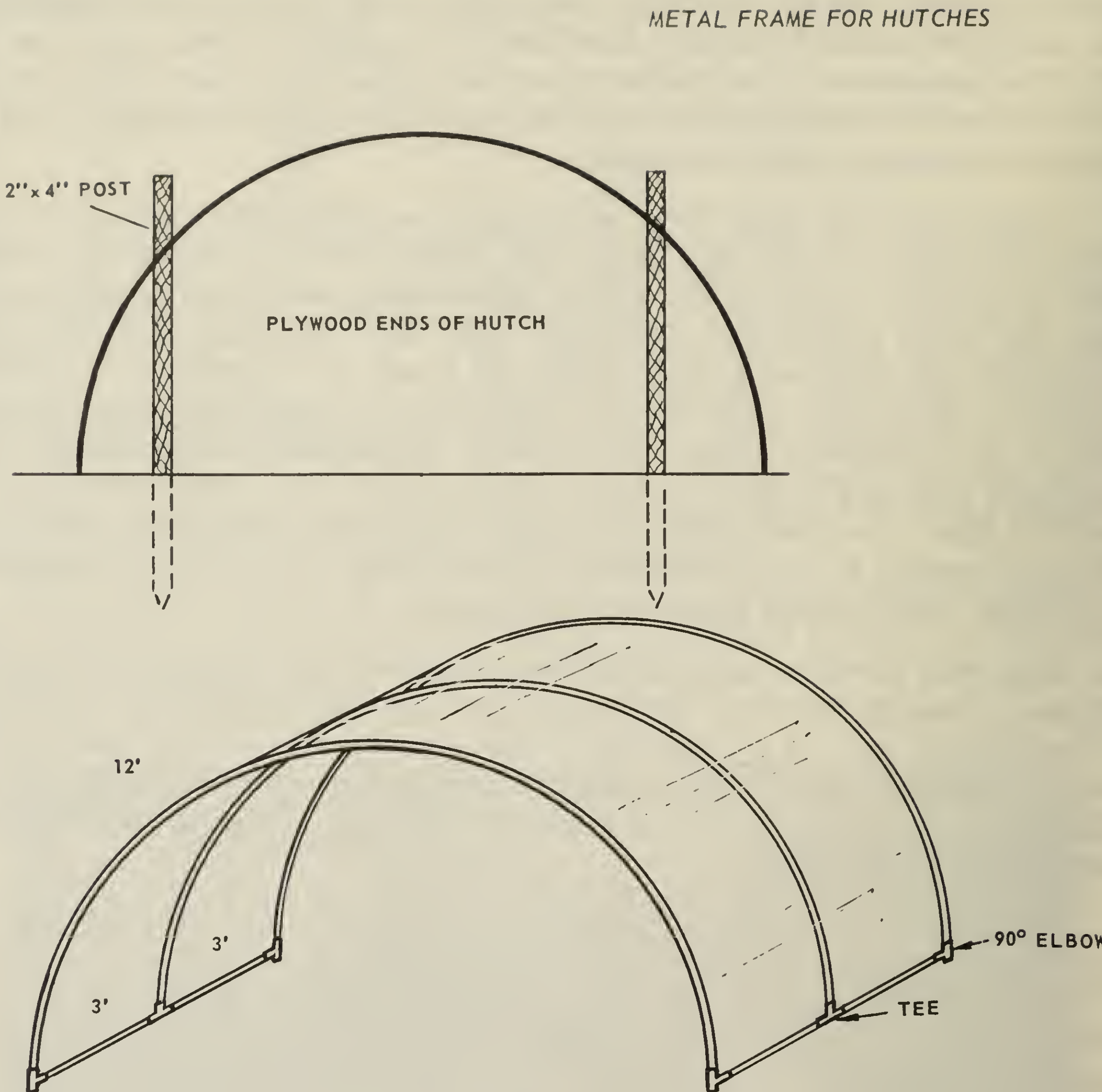


Figure 8 – Metal frames covered by a double layer of plastic material to provide crop shelters. The ends of such structures may be made of plywood as shown.

Row Covering

Plastics may be used for covering rows of plants in the garden. As with larger shelters, row covering may be used in conjunction with a hotbed or a cold frame. The plants may be started in the frame and then set out in the field. Instead of being individually protected by wax-paper covers, the plants are set out in two or more long rows and a tent of plastic is placed over these rows.

Many different types of row coverings may be used, depending on materials at hand. One grower, for example, makes wooden panels 3 feet wide by 8 feet long and sets them up, as in the frame shelters described previously, so as to cover two rows of plants. He has triangular pieces to put in place at the end of

each long row to adjust the heat inside the tent. He likes the panels for ease in planting, spraying, harvesting and ventilating. He prefers 2-gauge or .002 inch plastic for row covering.

Instead of frames or panels, wire wickets similar to those used in the game of croquet may be used to support the plastic over the plants. One is a smooth No. 9 gauge wire in the form of an oval. Another kind has two notches into which the plastic can be tucked.

Place the two types alternately, at intervals of about 2½ feet. Apply the plastic either as a wide, continuous sheet extending over the wickets and held down at the edges by soil, or as two single strips, secured in the same way at the edges and lapped together over the wickets. If you use a continuous sheet it should be at least 36 inches wide, and if you use two strips each must be about 24 inches wide to allow for lapping at the top of the wickets.

If you use the continuous sheet method, cut slits about 15 inches long in the plastic where it goes over one of the notched wickets. This is done to permit inspection and ventilation. To prevent the slits from being torn larger by wind or use, fold the plastic laterally at the ends of the slits and double or pin 4-inch squares of plastic to each fold. For ventilation tuck the sides of the slit into the notches of the notched wickets. This method provides more protection from high winds than the other.

If you use the two single sheets of narrow plastic you must secure them to the ground on each side of the row with soil and lap them over the wicket by about 4 inches. A 3-foot width of plastic will be necessary for protecting either large or tall plants. Draw the sheets tight at the top so that the lap stays closed and pin them with a 2-inch finishing nail at each smooth wicket. Use a 3- by 4-inch piece of .003-inch plastic as a reinforcement at the point of pinning. Do not pin the sheets where they are supported by the notched wickets. It is at these places that you pull open the plastic to provide ventilation, let in rain, or work with the plants. At those times the plastic is tucked into the notches in the wickets. Afterward the plastic can be pulled out of the notches, and it will resume its former position over the top of the wicket, making the lap air-tight again. Every third space can be left open at all times except on frosty nights, when all should be shut. More spaces can be opened on exceptionally hot, sunny days. If the soil is dry all laps can be opened before a rain.

If the soil is placed properly on the edges of the plastic and the laps are pinned securely to hold them firmly to the wickets, no damage from wind and rain storms can occur. Dig out the soil under the edge of the plastic with a tile spade and put it on top of the edge; tramping on this soil helps to hold it firm. The plastic should be kept stretched while it is being put on. It will help if the last wicket in each row is fastened to a stake driven beyond the end of the row; draw the wicket to the stake by short wires to keep the ends of the plastic taut.

Mulching

Polyethylene plastic mulches have been used successfully in certain gardens. These replace, to some extent, straw, manure or sawdust mulches that are sometimes used for horticultural crops. Organic mulching materials reduce

soil compacting and evaporation of moisture but they actually lower the temperatures because they insulate against the hot sun. This last disadvantage may be partially overcome by the use of plastics.

Plastic mulches are beneficial either in dry weather or during heavy rains. In the first case, they conserve moisture; in the second, they prevent packing of the soil, and spotting and soiling of the fruits and vegetables.

Black polyethylene plastic does not increase the temperature as much as the clear material does. The black, however, smothers weeds, while the clear material encourages all growth.

The best weight or thickness to use is .0015 or .002 gauge and this costs a little less than a cent a square foot, depending on width and size of roll.

If all the rain is necessary for good growth, then the ground should be lower along the crop row. This will cause the rain water to run into the center and filter into the soil through the holes around the plants. The polyethylene is laid flat on the ground and over the row and anchored with soil along the edges, If the seed is sown before the mulch is laid, holes must be cut in the plastic to allow the plants to emerge. The plastic may be laid down first and holes cut to allow transplants to be put in later at the proper intervals.

GREENHOUSES

This is an extensive topic and cannot be discussed here in detail. Many types of commercial greenhouses are now in use and these range in cost according to type. Our subject will be confined to homemade models in which costs and practicability are the main consideration.

The greenhouse may be used just for starting seedlings, before they are transplanted to row shelters, mulched rows or open gardens. On the other hand, greenhouses may first be used for starting from seed plants such as cabbage, cauliflower, celery, onions, tomatoes or other vegetables that are set out when the garden soil warms up. Then the benches are again planted with very tender crops such as cucumbers, peppers, egg plants or later-maturing tomatoes, which are left to grow till harvest time.

In many cases a small greenhouse may be attached to the house or any heated building and may need very little additional heat. Some small greenhouses may be heated with oil space heaters or by gas if this service is available. In most cases it is necessary to provide for heat only during early spring; after this season, ventilation and keeping the temperature down are often the problem.

Greenhouses discussed here are very seldom used throughout the year. Simple construction depends largely on available materials. There is no doubt that permanent glass houses are the best but these cost a large sum of money, both for the initial materials and for the transportation into remote places. Quite often the upkeep for glass, paint and putty is a considerable item. When these things are considered, a decision as to type of construction has to be made.

A very good greenhouse (Figure 9) can be built from 2- by 4-inch and 2- by 2-inch lumber and a double layer of plastic. This requires, for the side walls, uprights of dimensions 2 inches by 2 inches by 4 feet and a 2- by 4-inch plate on

which 2- by 2-inch rafters are erected to make a steep roof. If a large greenhouse is wanted, heavier side-wall frames and rafters have to be used. To allow the snow to slide off readily the angle of the eaves should be 40° instead of 33°, the

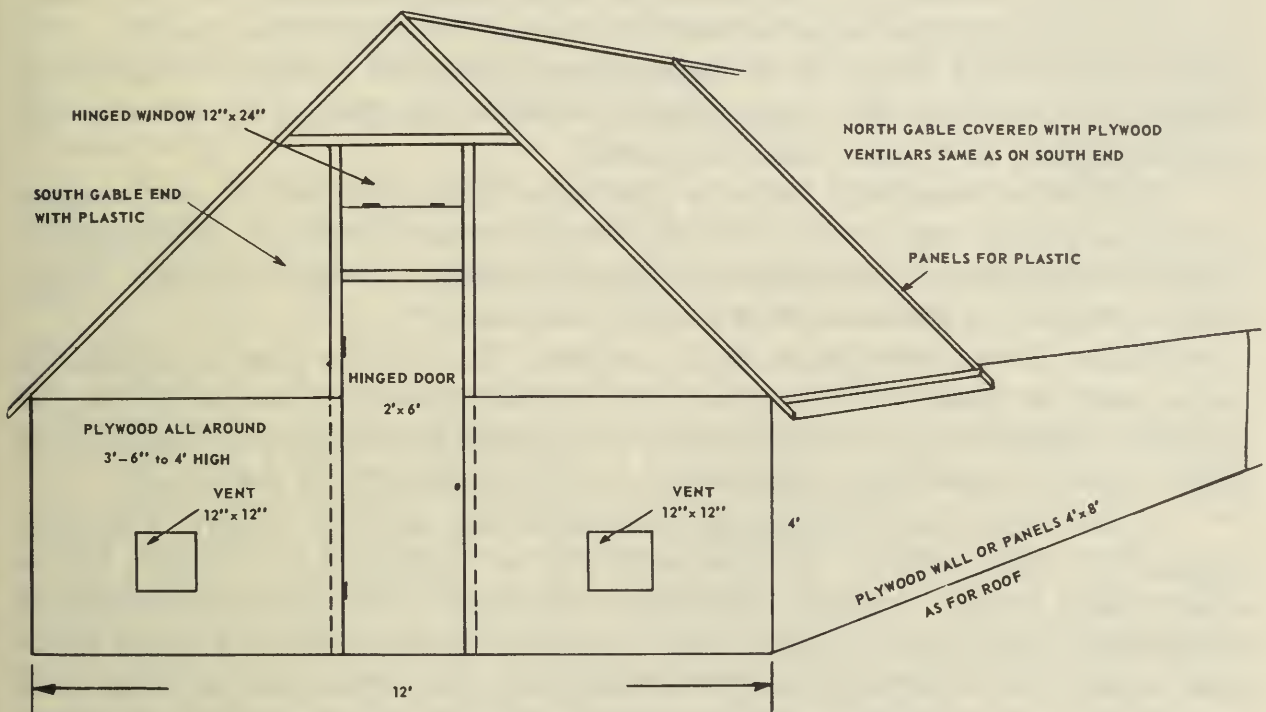


Figure 9 – One type of home-made greenhouse that may be covered with plastic as described in the text.

Figure 10 – A greenhouse made of logs, old sash windows and other materials on hand at Old Crow, Y.T. 72 miles north of the Arctic Circle.

pitch of roof in a standard house. Provision has to be made for ventilation by having adjustable windows in the gable ends and openings of the side walls (Figure 10). Combination screen and plastic doors may be used also to good advantage.

For good results, polyethylene of about 4-mil thickness for the outside layer and 2-mil for the inside should be carefully installed. The outside of the plastic may be first tacked to the rafters, but, in addition it must be fastened by ¼-inch by 1-inch lath. The inside plastic which is not affected by the wind may be held in place with paper disks and tacks.

The frame house must be made rigid with diagonal braces. To add strength and to keep down the amount of wood, which causes shading, it is possible to use No. 9 wire braces and turnbuckles inside the house, under the rafters. These are put on after the inside layer of plastic is in place.

Such a house must be properly anchored. This may be done by having the corner posts go down 2 to 3 feet below the bottom plate and imbedded in concrete footings. Another way is to first install the anchors or footings and then bolt the bottom plate to these before beginning the main construction of the house.

A very sturdy yet inexpensive greenhouse may be built largely of plywood (Figure 11). The frame for the side-walls may be made from 2- by 4-inch lumber or any cheap lumber, or even cedar posts. The frame is then covered both inside and outside with ¼-inch plywood, and as a result there is dead air space in the side walls. The walls may be 2 to 4 feet high. The rafters for the greenhouse are made by laminating three layers of 3/8-inch fir plywood that has been bonded with waterproof glue. To make these rafters lay a sheet of plywood flat on the

Figure 11 – Greenhouse with laminated plywood rafters at the Experimental Sub-station, Fort Chimo, Que.

floor and using a homemade compass (a nail driven into the floor as the center point, a wire 6 feet long for the radius, and a pencil at the other end of the wire) draw an arc along the longest part of the plywood sheet. The center point, of course, will be some distance away from the sheet of plywood. Now, move the center point 2¼ inches away from the sheet and draw another arc parallel to the first. Using an electric saber saw or a fine-toothed hand saw, cut carefully on the pencilled marks on the plywood so as to get an arc a full 2 inches wide. This will be the right curve and width for marking and cutting the entire sheet of plywood in order to make laminated rafters. It takes a little more than one sheet, 4 by 8 feet, to make two rafters. Arrange the arcs on the floor; laminate three layers, using waterproof glue, and clinch the nails. These rafters, then, are 1 1/8 inches thick and 2 inches deep, and they form a full semicircle having a radius of 6 feet. They must be thoroughly sanded to remove the sharp edges that might tear the plastic. The width of such a greenhouse will be 12 feet. The bottoms or ends of the rafters have to be notched to fit over the sidewalls, where they are fastened with wood screws. At the top there must be a ridge pole 2 by 3 inches with notches 1 inch deep to receive the rafters. These rafters are spaced on 20- or 24-inch centers, depending on the width of the plastic material to be used for covering. Additional dividers and supports may be used. The plastic must be carefully fastened down with narrow laths on the outside. It is important to have diagonal braces at the four corners of the greenhouse. Doors may be set in 2- by 4-inch frames at each end of the house. There should be combination doors with removable panels to provide for cross-ventilation.

To make the house fully insulated it is best to use a double layer of plastic. As in houses of regular shape, the outside layer could be 4-mil (.004) or heavier polyethylene. If greater durability is required 10-mil cellulose-acetate-butyrate sheeting, could be used. The inside layer might be 2-mil polyethylene.

Greenhouses may be heated in various ways. If they are used very early in the spring, oil space heaters may be necessary. For small houses, if the outside temperatures do not go down too low, and if electricity is available and not too expensive, 1,500-watt electric heaters may be sufficient.

A factory-made arch-type greenhouse is offered that consists of semicircular aluminum frames covered with one-piece plastic. The cost of the smallest unit (20 x 32 ft.) complete with 4-mil polyethylene cover, gable ends, floors and fan would be about $700 before freight charges. An oil-fired hot-air heater, thermostatic controls, and other accessories would raise this price by at least $450.

INSECTS AND DISEASES

There are several kinds of insects and diseases that may be destructive to garden crops. The most concise information on the control of these is "Protection Calendar for Vegetables", a leaflet prepared by the Ontario and Canada depart-

ments of agriculture, and it may be obtained free from the Extension Branch, Ontario Department of Agriculture, Toronto, Ontario.

Perhaps the most troublesome insect is the flea beetle, which attacks vegetable seedlings as they emerge. This insect is about the size of a pinhead, is black, shiny, and very active. It jumps when disturbed and may be undetected except for the damage it leaves behind. It feeds on young plants by puncturing the leaves and stems of raddish, cabbage, cauliflower, beet, turnip, swiss chard, potato and tomato. Leafhoppers may also do serious damage. Dusting or spraying with DDT or chlordane controls most insects.

A derris compound, which is nonpoisonous to people, will control the cabbage worm. To reduce cutworm damage to cabbage it is well to wrap the stems or transplants loosely in pieces of newspaper. Aldrin dusted on the ground around the plants will kill cutworms by contact. Poison baits are also effective. Be sure to get your "Protection Calendar" early and have some common insecticides on hand. This leaflet also deals with diseases such as damping-off, blight, wilt, etc. Therefore, it is worth while looking over for ways to save your garden crops.

SOME OTHER HELPFUL PUBLICATIONS

Annual Flowers for Canadian Gardens, by R. W. Oliver. Canada Department of Agriculture, Publication 796, 1955.

Growing Vegetables in the Prairie Garden, by Charles Walkof. Canada Department· Department of Agriculture, Publication 1033, 1960.

Home Vegetable Growing. Canada Department of Agriculture, Publication 1059, 1960.

Hotbeds and Coldframes. Canada Department of Agriculture, Publication 702, 1952.

Lime and other Soil Amendments. Canada Department of Agriculture, Publication 869, 1956.

Low-cost Plastic Greenhouses, by E.M. Emmert, Progress Report 28, Agricultural Experimental Station, Lexington, Kentucky, U.S.A., 1955.

Manures and Composts. Canada Department of Agriculture, Publication 868, 1951.

Plastic Row Covering for Producing Extra-early Vegetables Outdoors, by E.M. Emmert, Leaflet 167, University of Kentucky, College of Agriculture, Lexington, Kentucky, U.S.A., 1956.

Plastic Mulch for Vegetables, by E.M. Emmert. Leaflet 170, University of Kentucky, College of Agriculture, Lexington, Kentucky, U.S.A., 1956.

Potato Growing in Canada, by N.M. Parks. Canada Department of Agriculture, Publication 918, 1958.

Progress Reports from your nearest Experimental Farm or Station, Canada Department of Agriculture, for information on variety trials, fertilizers, etc.

Protection Calendar for Vegetables. Ontario Department of Agriculture, Extension Branch, Toronto, Ontario. Ask for latest issue.

Vegetable Gardening Practices for the Prairie Provinces. Canada Department of Agriculture, Publication 1070, 1960.

FOR FURTHER INFORMATION

If you want further information or advice on special problems, you might get in touch with the author or the Superintendent at any of the following Experimental Farms:

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Copies of this publication may be obtained from

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